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The millipede genus *Cryptocorypha* Attems, 1907 revisited, with descriptions of two new Oriental species (Diplopoda: Polydesmida: Pyrgodesmidae)

Снова о многоножках-диплоподах рода *Cryptocorypha* Attems, 1907 с описаниями двух новых ориентальных видов (Diplopoda: Polydesmida: Pyrgodesmidae)

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КЛЮЧЕВЫЕ СЛОВА: Diplopoda, *Cryptocorypha*, таксономия, новый вид, Лаос, Таиланд.

ABSTRACT. The largely Old World, tropical or subtropical diplopod genus *Cryptocorypha* Attems, 1907 is reviewed, with the following three new formal generic synonyms established: *Carlodesmus* Verhoeff, 1941, *Cryptomauritius* Verhoeff, 1941 and *Sisyrodesmus* Attems, 1912, all syn.n. Two species are newly synonymized: *C. fungifer* (Attems, 1953), comb.n. (= *C. leleupi* Golovatch, Nzoko Fiemapong et VandenSpiegel, 2017), and *C. riparia* (Carl, 1932), comb.n. (= *C. lawrencei* (Verhoeff, 1941)), both syn.n. Another two new species are described: *C. bicolorata* sp.n. from Laos and *C. jaegeri* sp.n. from northern Thailand. A provisional key is compiled to all 25 currently recognized species of *Cryptocorypha*, including two old congeners, *C. tobana* Chamberlin, 1945, from Sumatra, Indonesia and *C. leia* Chamberlin, 1945, from Java, Indonesia, based on a revision of their holotypes.

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РЕЗЮМЕ. Дан обзор диплопод в основном тропического рода *Cryptocorypha* Attems, 1907 с установленными тремя формально новыми родовыми синонимами: *Carlodesmus* Verhoeff, 1941, *Cryptomauritius* Verhoeff, 1941 и *Sisyrodesmus* Attems, 1912, все три syn.n. Предложены два новых видовых синонима: *C. fungifer* (Attems, 1953), comb.n. (= *C. leleupi* Golovatch, Nzoko Fiemapong et VandenSpiegel, 2017), и *C. riparia* (Carl, 1932), comb.n. (= *C. lawrencei* (Verhoeff, 1941)), оба syn.n. Описаны два новых вида: *C. bicolorata* sp.n. из Лаоса и *C. jaegeri* sp.n. из Северного Таиланда. Представлен предварительный ключ для всех 25 ныне признанных видов рода *Cryptocorypha,* включая два старых вида, *C. tobana* Chamberlin, 1945, с Суматры (Индонезия) и *C. leia* Chamberlin, 1945, с Явы (Индонезия), на основе ревизии их голотипов.

Introduction

The mainly Old World, tropical or subtropical millipede genus *Cryptocorypha* Attems, 1907 has only recently been reviewed, rediagnosed and shown to comprise 21 species [Golovatch *et al.*, 2017; Likhitrakarn *et al.*, 2019]. The issue, however, needs to be revisited not only because of two new species to be described, but also to document a few new synonymies, to transfer two new congeners, and to revise the holotypes of another two old species.

Material and methods

The type series of both new *Cryptocorypha* were borrowed from and will be returned to the collection of the Senckenberg Naturmuseum, Frankfurt a.M. (SMF), Germany. The holotypes of two old species of R.V. Chamberlin were borrowed from the American Museum of Natural History (AMNH), New York and revised at the Museum of Comparative Zoology (MCZ) in Harvard, USA.

Colour pictures of the new species were most skillfully taken and stacked by Kirill Makarov (Moscow, Russia), whereas those of Chamberlin's congeners by Mrs Jennifer Trimble (MCZ).

Taxonomy

Cryptocorypha Attems, 1907

Type-species: *Cryptocorypha stylopus* Attems, 1907, Java, by monotypy.

= *Procoptodesmus* Brolemann, 1920, synonymized by Golovatch *et al.* [2017].

Type-species: *Procoptodesmus diffusus* Brolemann, 1920, Tanzania, by original designation.

= *Archandrodesmus* Carl, 1932, synonymized by Hoffman [1977].

Type-species: *Archandrodesmus areatus* Carl, 1932, India, by original designation.

= *Platykapelus* Attems, 1938, synonymized by Hoffman [1977].

Type-species: *Platykapelus ornatus* Attems, 1938, Hawaii, by original designation.

= *Cryptomauritius* Verhoeff, 1941, **syn.n.**

Type-species: *Cryptomauritius lawrencei* Verhoeff, 1941, Mauritius, by monotypy.

= *Ceyloncarlia* Verhoeff, 1941, synonymized by Hoffman [1977].

Type-species: *Archandrodesmus kandyanus* Carl, 1932, Sri Lanka, by monotypy.

= *Afrocorypha* Loksa, 1967, the Republic of the Congo, synonymized by Golovatch *et al.* [2017].

Type-species: *Cryptocorypha* (*Afrocorypha*) *nympha* Loksa, 1967, by monotypy.

= *Sisyrodesmus* Attems, 1912, **syn.n.**

Type-species: *Sisyrodesmus girafficeps* Attems, 1912, Rwanda, by monotypy.

= *Carlodesmus* Verhoeff, 1941, **syn.n.**

Type-species: *Archandrodesmus riparius* Carl, 1932, India, by monotypy.

Among others, both *Carlodesmus* and *Sisyrodesmus* have long been circumscribed [Hoffman, 1977] as a group of genera deemed to be especially close to *Cryptocorypha*, but so far their synonymies have never been formalized. In addition, Hoffman [1977] correctly noticed that *Cryptomauritius lawrencei* Verhoeff, 1941, from Mauritius [Verhoeff, 1941], is fully identical to ?*Archandrodesmus riparius* Carl, 1932, from southern India [Carl, 1932], but he regarded this species sufficiently distinct from *Cryptocorypha* (= *Archandrodesmus*) spp. at the generic level to warrant the recognition of *Cryptomauritius* as a separate genus [Hoffman, 1977, 1980]. However, because all of them clearly show basically the same somatic and gonopodal conformations (see a refined diagnosis below), they are treated here as a single large genus.

All species previously included in *Cryptocorypha* have recently been listed, with complete data on their distributions also provided [Likhitrakarn *et al.*, 2019]. That listing is briefly repeated below and the species are arranged in alphabetic order: *C. areata* (Carl, 1932); *C. bocal* Golovatch, Nzoko Fiemapong et VandenSpiegel, 2017; *C. chernovi* Golovatch, Geoffroy et VandenSpiegel, 2013; *C. diffusa* (Brolemann, 1920); *C. dimorpha* Golovatch, Nzoko Fiemapong et VandenSpiegel, 2017; *C. enghoffi* Likhitrakarn, Golovatch, Strisonchai, Sutcharit et Panha, 2019, *C. hoffmani* Golovatch, Semenyuk, VandenSpiegel et Anichkin, 2011; *C. japonica* (Miyosi, 1957); *C. kandyana* (Carl, 1932); *C. kumamotensis* (Murakami, 1966); *C. leia* Chamberlin, 1945; *C. leleupi* Golovatch, Nzoko Fiemapong et VandenSpiegel, 2017; *C. monomorpha* Golovatch, Nzoko Fiemapong et VandenSpiegel, 2017; *C. nympha* Loksa, 1967; *C. ornata* (Attems, 1938); *C. perplexa* Golovatch et VandenSpiegel, 2015; *C. spinicoronata* (Zhang et Li, 1981); *C. stylopus* Attems, 1907 (the type species); *C. tobana* Chamberlin, 1945; and *C. tuberculata* (Carl, 1932). At least further two, apparently new, but yet undescribed species of *Cryptocorypha* have recently been recorded from Nepal [Golovatch, Martens, 2018].

With the above synonymization of *Carlodesmus* Verhoeff, 1941, *Cryptomauritius* Verhoeff, 1941 and *Sisyrodesmus* Attems, 1912 under *Cryptocorypha*, the following new transfers, as well as two new specific synonymies are warranted: *C. riparia* (Carl, 1932), comb.n. ex *Carlodesmus*; *C. lawrencei* (Verhoeff, 1941), comb.n. ex *Cryptomauritius*; *C. riparia* (Carl, 1932) = *C. lawrencei* (Verhoeff, 1941), syn.n.; *C. coalita* (Attems, 1953), *C. fungifer* (Attems, 1953) and *C. girafficeps* (Attems, 1912), all comb.n. ex *Sisyrodesmus*; *C. fungifer* (Attems, 1953) = *C. leleupi* Golovatch, Nzoko Fiemapong et VandenSpiegel, 2017, syn.n., these two latter species coming even from the same type locality: Itombwe, the Democratic Republic of the Congo.

Another genus, *Aporodesminus* Silvestri, 1904, with only one accepted species, *A. wallacei* Silvestri, 1904 (= *Cryptocorypha napoleonis* Attems, 1907, synonymized by Hoffman [1977]), almost fully fits in the diagnosis of *Cryptocorypha*, particularly its gonopodal traits. Like *C. ornata*, *A. wallacei* is nearly pantropical and semi-aquatic, and it is also widely scattered across the islands and archipelagos of the Atlantic and Pacific oceans, including a creek at Sydney, Australia (see Adis *et al.* [1998]). Superficially, *A. wallacei* differs strongly enough from *Cryptocorypha* in the absence of ozopores and the related reduction of the number of lateral lobulations on all postcollum paraterga to three, while the gonopodal telopodites are clearly tripartite, *vs.* quadripartite in *C. ornata* [Silvestri, 1904; Attems, 1907b, 1938, 1940; Hoffman, 1977; Adis *et al.*, 1998]. Taking into account the particularly profound variations observed in the distribution and location of ozopores within the family Pyrgodesmidae, in which far too many genera, including numerous monotypic ones, are still based on peculiar pore formulae (e.g. Attems [1940]), it would seem tempting to synonymize these two genera as well. However, I suggest first to compare both these species and their genera using molecular evidence. In addition, formal synonymy would inflict numerous taxonomic transfers, as *Aporodesminus* is older than, and thus has priority over, *Cryptocorypha*. So let this challenge be deferred for the future.

Considering both new Indochinese species described below, the diversity of described/accepted *Cryptocorypha* spp. currently amounts to 25. A key to all of them will conclude the present contribution.

The distribution of *Cryptocorypha* is basically Old World, largely restricted to the tropics or subtropics, and it covers central and eastern Africa, through Nepal, India, Sri Lanka and Myanmar, to East Asia, southern China, Indochina, western Indonesia, and even Melanesia; one species (*C. ornata*) is particularly widespread, likely due to ornitho- and/or anthropochory introduced

to several remote islands and archipelagos in the Indian and Pacific oceans [Adis *et al.*, 1998; Golovatch *et al.*, 2017].

A refined diagnosis of *Cryptocorypha*

The diagnosis of *Cryptocorypha* can now be refined as compared to the ones provided recently [Golovatch *et al.*, 2017; Likhitrakarn *et al.*, 2019]:

A genus of small Pyrgodesmidae (4–15 mm long) with a strongly flat body and high paraterga. Adult body with 19 or 20 segments in both sexes, but more usually with 19 segments in ♂ and 20 segments in ♀. Head usually unmodified, only in several Afrotropical species with a paramedian pair of vertigial humps (only in ♂ or both in ♂ and ♀). Antennae C-shaped, mostly exposed, antennomere 6 the largest; interantennal isthmus > 1.6 times as great as diameter of antennal socket. Collum flabellate, fully or almost fully covering the head from above, fore margin regularly convex, not or nearly not lobulated, but with 6+6 (sub)equal sectors divided by 11 radii; central part usually with two transverse rows of 3+3 and 2+2 flat, roundish or transversely oval bosses or low tubercles; sometimes both rows and knobs being vague. Postcollum metaterga each with three transverse rows of regular, non-differentiated, flat bosses or low rounded tubercles partly extending onto paraterga. Lateral margin of postcollum paraterga always indistinctly lobulated, without porosteles: paraterga 2 and 3 invariably trilobate, following ones 3-, 4- or 5-lobate, but poreless paraterga showing fewer lobulations (typically three) than pore-bearing ones (typically four). Anterolateral lobulations absent, but caudolateral ones present (1–3). Tergal setae missing. Pore formula normal (5, 7, 9, 11, 13, 15–18(19)), ozopores inconspicuous, open flush on tergal surface near base of penultimate lateral lobulation. Telson fully exposed in dorsal view, epiproct conical. Last tibia or both last and penultimate tibiae (♂ and/or ♀) often, but not always with an apicodorsal trichostele (= a long tactile seta on stalk or knob).

Gonopods from relatively simple (e.g. *C. hoffmani* or *C. nympha*) to complex (e.g. *C. diffusa* or *C. jaegeri* sp. n., Figs 9–10), typically clearly transverse; coxae globose, each usually with one or a few strong setae, laterally papillate and microsetose, usually divided by a central sternal tubercle; cannulae unmodified curved tubes; telopodites remaining well-exposed beyond a small to modest gonocoel, each typically tri- or quadripartite, consisting of a distinct mesal solenomere (**sl**) branch flanked by a more or less prominent, membranous, sometimes ornate, sac- or lobe-shaped, anterolateral velum (**v**), and a normally long and lateral exomere process (**ex**). Sometimes both **v** and **ex** either fully fused into a single sac-shaped structure (*C. hoffmani*) or **v** more or less strongly appressed to **ex** (*C. japonica*, *C. hoffmani*, *C. stylopus*) or **en** (*C. enghoffi*), leaving gonopodal telopodite bi- or poorly tripartite. When telopodite clearly quadri- or tripartite, a more or less evident endomere (**en**) branch normally also distinct (Figs 4–5, 9–10, 17–18).

Descriptions of two new species

Cryptocorypha bicolorata **sp.n.**
Figs 1–5.

HOLOTYPE ♂ (SMF), Laos, Bolakhamsay Prov., Lak Sao, Tham Man Kane, ca. 500 m a.s.l., N 18°13′16.1″, E 104°48′45.9″, inside cave, 27.II.2012, leg. P. Jäger.

DIAGNOSIS. Differs from other species of the genus by the absence of trichosteles on the last tibiae, combined with a colour pattern, a stout body (length/width ratio ca. 2.4), and the quadripartite gonopodal telopodites (see also Key below).

NAME. To emphasize the bicoloured, brown-and-white pattern.

DESCRIPTION. Length ca. 7.0 mm, width of midbody pro- and metazonae 1.0 and 2.9 mm, respectively. General coloration in alcohol (Figs 1–2) grey-brown, pattern including darker mid-dorsal parts, prozonae and laterad increasingly marbled and light paraterga, as well as distad increasingly infuscate antennae (antennomere 7 darkest, dark brown), whereas most of head and epiproct, anterior 1/4 collum, lateral ¼ in all following paraterga, caudal margins of all metaterga, sides, venter and legs, all rather contrasting light grey, light brown or nearly pallid, only tips of antennae pallid.

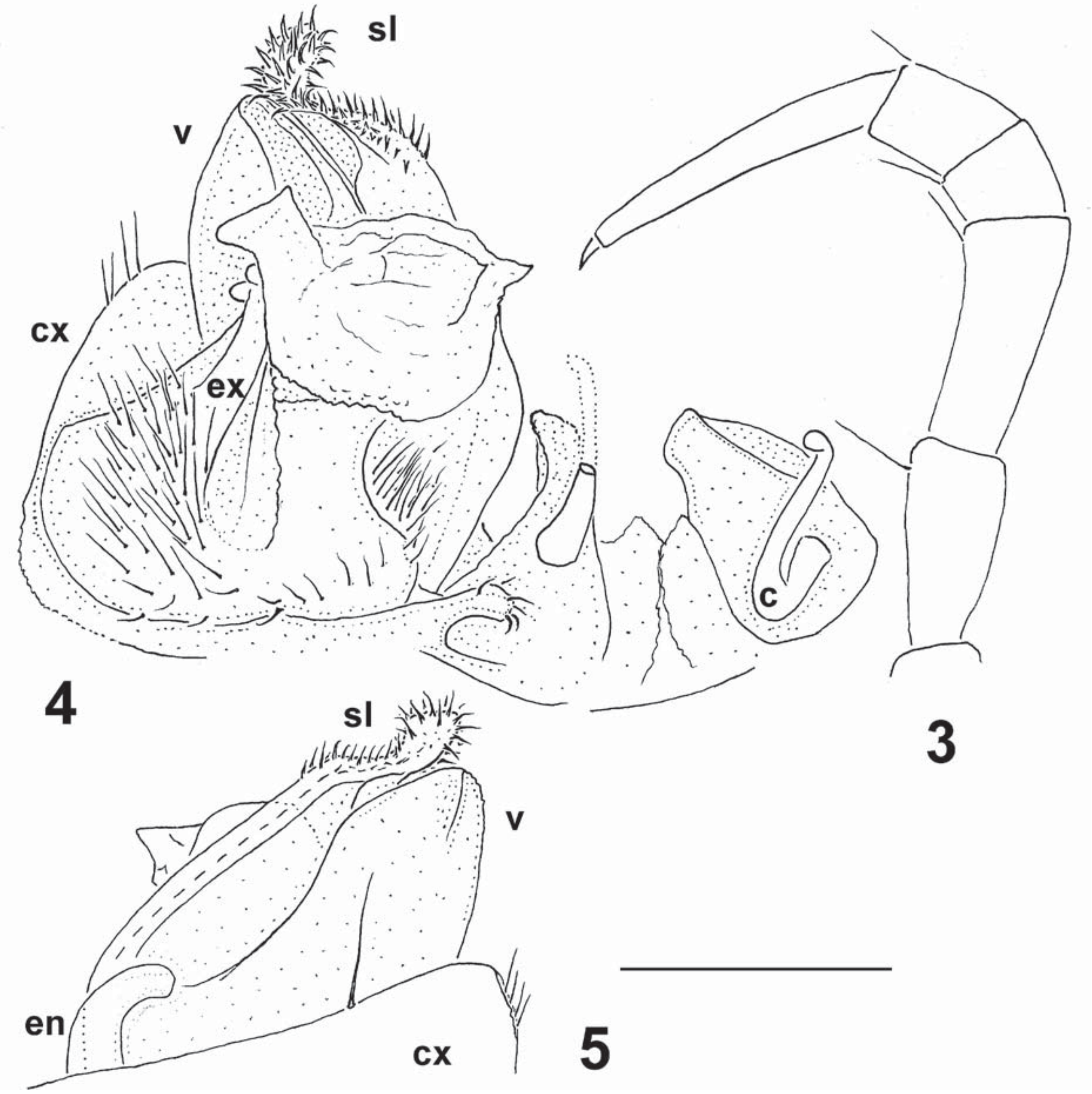
Body with 20 segments. In width, head << collum < segment 2 < 3 < 4=15; thereafter body rapidly tapering towards telson. Head very densely setose and microgranulate, between and behind antennae on vertex more roughly granulate, mostly dull; epicranial suture superficial, more distinct in vertigial region. Antennae long, slender and very densely setose, only slightly clavate, C-shaped (Fig. 2); in length, antennomere 1 = 7 < 2 = 4 << 5 < 3 = 6; antennomere 6 highest, both 5th and 6th with a small, compact, apicodorsal group of minute bacilliform sensilla. Interantennal isthmus ca. 1.8 times as broad as diameter of antennal socket.

Tegument dull dorsally, only legs shining. prozonae and strictures similarly finely shagreened/micro-alveolate. Dorsum very moderately and regularly convex; paraterga mostly set at about upper 1/3 of body, very strongly developed, beginning with collum, regularly declined ventrad much like dorsum (Figs 1–2). Collum flabellate, completely covering the head from above, tauriform, anterior half as usual, flattened, posterior half slightly and regularly elevated, with a few vague, transverse, irregular rows of small, mostly transverse, obliterated tuberculations; anterior margin regularly rounded, with 6+6 equal sectors. Postcollum paraterga very broad (prozona to metazona width ratio ca. 1:3), flat, only slightly declined ventrad, each much broader than prozona; anterior margin/shoulder always entire, mostly nearly straight and narrowly bordered, increasingly, but faintly curved caudad towards telson, with neither radii nor crenulations; only anterolateral corner slightly rounded. Tergal setae absent. Each poreless or pore-bearing paratergum with three or four subequal lobulations, respectively, along a nearly straight lateral edge, caudal corner drawn increasingly behind rear tergal margin only in segments 17–19; paraterga 19 directed caudad, but slightly shorter than epiproct (Fig. 1). Caudal margins of paraterga increasingly strongly lobulate and radiate laterad, with 1–1.5 lobulations on each side before bases of paraterga, regardless of caudolateral ones (Figs 1–2).



Figs 1–2. Habitus of *Cryptocorypha bicolorata* sp.n., ♂ holotype, dorsal and ventral views, respectively. Pictures by K. Makarov, taken not to scale.

Рис. 1–2. Общий вид *Cryptocorypha bicolorata* sp.n., голотип ♂, соответственно сверху и снизу. Фотографии К. Макарова, сняты без масштаба.



Figs 3–5. *Cryptocorypha bicolorata* sp.n., ♂ holotype: 3 — leg 9, lateral view; 4–5 — right gonopod, mesal and lateral views, respectively. Scale bar: 0.2 mm (3), 0.4 mm (4–5).

Abbreviations: c — cannula; cx — coxite; en — endomere; ex — exomere; sl — solenomere; v — velum.

Рис. 3–5. *Cryptocorypha bicolorata* sp.n., голотип ♂: 3 — нога 9, сбоку; 4–5 — правый гонопод, соответственно изнутри и сбоку. Масштаб: 0,2 мм (3), 0,4 мм (4–5).

Обозначения: c — канюля; cx — коксит; en — эндомер; ex — экзомер; sl — соленомер; v — парус.

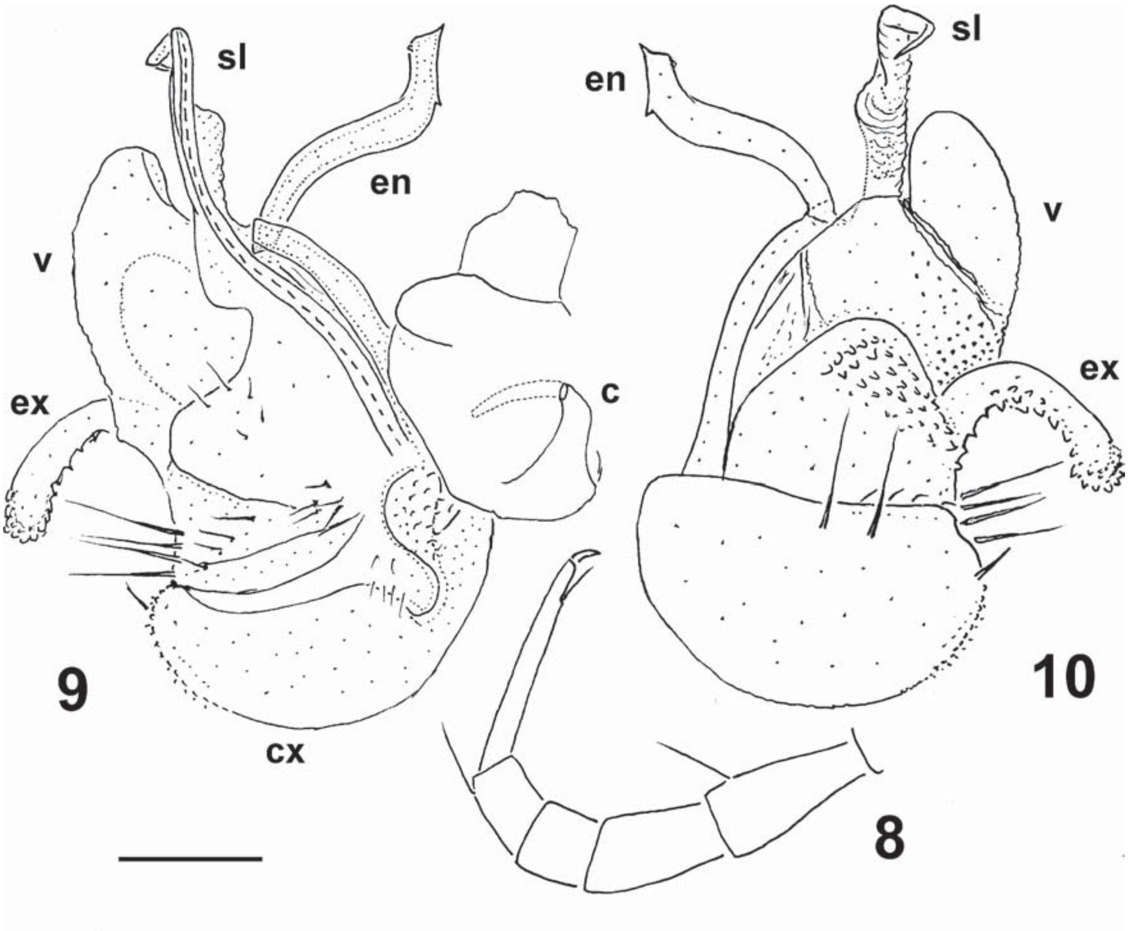
Mid-dorsal parts of postcollum metaterga with three transverse and regular rows of small, mostly subtransverse, obliterated, often lighter tubercles/knobs: paramedian 1+1, 2+2 and 2+2 in anterior, middle and caudal rows, respectively, plus a similar knob near centre of each paratergum. Axial line superficial, about as evident as both sulci dividing the transverse rows of tubercles. Pleurosternal carinae wanting. Pore formula normal, ozopores opening flush dorsally near base of penultimate lobulation of each pore-bearing paratergum. Stricture dividing pro- and metazonae narrow and shallow. Limbus brush-like, very densely microspiculate. Epiproct conical, dorsal and lateral tubercles evident. Hypoproct subtrapeziform, 1+1 caudal setae clearly separated, borne on small, but evident knobs.

Sterna very narrow (Fig. 2), densely setose, deeply impressed along main axis. A small, but evident sternal tooth present only near each of coxae 10 and 11 (♂) (Fig. 2). Legs long and rather slender (Fig. 3), about as long as paraterga, very densely setose, last tibiae without trichosteles (Fig. 2); in length, tarsi > femora > prefemora >> tibiae > postfemora = coxae; gonapophyses on ♂ coxae 2 small cones; neither adenostyles nor tarsal brushes. Claws simple, slightly curved ventrad. Gonopod aperture transversely oblong-oval, caudal and lateral margins thin and slightly elevated.



Figs 6–7. Habitus of *Cryptocorypha jaegeri* sp.n., ♂ holotype, dorsal and ventral views, respectively. Pictures by K. Makarov, taken not to scale.

Рис. 6–7. Общий вид *Cryptocorypha jaegeri* sp.n., голотип ♂, соответственно сверху и снизу. Фотографии К. Макарова, сняты без масштаба.



Figs 8–10. *Cryptocorypha jaegeri* sp.n., ♂ holotype: 8 — leg 9, lateral view; 9–10 — right gonopod, mesal and lateral views, respectively. Scale bar: 0.1 mm (8), 0.2 mm (9–10).

Abbreviations: c — cannula; cx — coxite; en — endomere; ex — exomere; sl — solenomere; v — velum.

Рис. 8–10. *Cryptocorypha jaegeri* sp.n., голотип ♂: 8 — нога 9, сбоку; 9–10 — правый гонопод, соответственно изнутри и сбоку. Масштаб: 0,1 мм (3), 0,2 мм (4–5).

Обозначения: c — канюля; cx — коксит; en — эндомер; ex — экзомер; sl — соленомер; v — парус.

Gonopods (Figs 4–5) *in situ* held parallel to each other, complex (Fig. 2). Coxite (**cx**) relatively large, subtending and concealing basal half of telopodite; cannula (**c**) as usual. Each telopodite grossly quadripartite and very strongly exposed: a conspicuous, long, ribbon-shaped, acuminate endomere (**en**) about as high as a slender, distally rugulose, unciform and also acuminate solenomere (**sl**), followed first by a simple and lower sac-shaped velum (**v**) and then a relatively short, erect, basally densely setose, rod-shaped, apically vaguely bifid exomere (**ex**).

REMARK. This is the first *Cryptocorypha* to be documented from Laos.

Cryptocorypha jaegeri sp.n.
Figs 6–10.

HOLOTYPE ♂ (SMF), Thailand, Chiang Mai Prov., W of Chiang Mai, Doi Suthep temple, bus parking area, ca. 1005 m a.s.l., N 18°48′3.4″, E 98°55′7.8″, daytime, by hand and sifting, 3.VII.2014, leg. P. Jäger.

DIAGNOSIS. This species is distinguished from other species of the genus by the presence of trichosteles on the last tibiae, combined with the quadripartite gonopodal telopodites (see also Key below).

NAME. Honours Peter Jäger (SMF), the collector.

DESCRIPTION. Length ca. 8.0 mm, width of midbody pro- and metazonae 0.9 and 1.9 mm, respectively. General coloration in alcohol (Figs 6–7) marbled rusty brown, but head, antennae, prozonae, strictures, venter, legs, tips of antennae and all margins of collum and following metaterga light grey-yellow or -brown to (nearly) pallid; antennomere 7 contrasting infuscate, brown.

All characters as in *C. bicolorata* sp.n., except as follows.

Antennae a little shorter and stouter, quite clearly clavate (Fig. 6); in length, antennomere 1 < 2 = 4 = 7 << 5 < 3 = 6. Interantennal isthmus ca. 2.0 times as broad as diameter of antennal socket.

Tegument dull dorsally, metaterga in places with a thin cerotegument crust. prozonae and strictures finely shagreened/micro-alveolate. Collum in posterior half with a few small, vague and round knobs centrally arranged in 2–3 transverse and irregular rows; anterior margin regularly rounded, with 6+6 equal and faint sectors. Postcollum paraterga somewhat narrower (prozona to metazona width ratio ca. 1:2), Caudal

margins of paraterga increasingly strongly lobulate and radiate laterad, with only one lobulation on each side before bases of paraterga, regardless of caudolateral ones (Figs 6–7). Mid-dorsal parts of postcollum metaterga with three transverse and rather regular rows of small, mostly round tubercles/knobs: paramedian 1+1, 2+2 and 2+2 in anterior, middle and caudal rows, respectively, plus 1–3 similar knobs near centre of each paratergum; paramedian tubercles usually forming 2+2 regular serial rows, but axial line missing.

Sternite between coxae 9 somewhat broader than other sterna (♂), sternal cones totally missing. Legs shorter and stouter (Fig. 8), prefemora about as long as femora, last tibiae with distinct apicodorsal trichosteles (Fig. 7).

Gonopods (Figs 9–10) quite complex; coxite (**cx**) typically small, boat-shaped, gonocoel underdeveloped, cannula (**c**) as usual. Each telopodite grossly quadripartite: a short, ribbon-shaped, curved and apically rounded endomere (**en**) at base of the longest, distally curved, conspicuously and densely fringed/fimbriate, apically palm-shaped expanded solenomere (**sl**), followed first by a sac-shaped, mesally irregularly membranous velum (**v**) and then by a large, clearly papillate/dentate, gently curved, somewhat clavate exomere (**ex**).

REMARKS. This is only a second *Cryptocorypha*, pyrgodesmid and generally micropolydesmid to be reported from Thailand [Likhitrakarn *et al.*, 2019]. There can be no doubt whatever that this is only a miserable fraction of the real diversity of these three groups in Indochina.

Revision of two old species of R.V. Chamberlin

As long emphasized elsewhere [Golovatch *et al.*, 2011, 2013; Golovatch, VandenSpiegel 2015], because two old species, *C. leia* Chamberlin, 1945, from Java, Indonesia and *C. tobana* Chamberlin, 1945, from Sumatra, Indonesia, had been described too poorly [Chamberlin, 1945], no meaningful key to *Cryptocorypha* spp. could ever be attempted. To finally shed the light on the identities of these two little-known congeners, as well as to be able to finally incorporate them into a key, I have received on loan and revised both relevant holotypes.

Cryptocorypha leia Chamberlin, 1945
Figs 11–13.

HOLOTYPE ♂ (AMNH), Indonesia, Java, Goenoeng Malabar, 1600 m, Dec. 20th, 1920. The label fully coincides with the one given in the original description [Chamberlin, 1945], the collector(s) remaining unknown.

DESCRIPTIVE REMARKS. The holotype is presently incomplete, fragmented, broken into four pieces (Fig. 11), with the head, collum and segment 7 missing. Based on the last four paraterga being 4-lobulated, the entire number of body segments can be reconstructed as having been 19 (♂). Body width was originally stated as being 2.0 mm [Chamberlin, 1945]. The last tibia is with an evident trichostele.

All somatic characters are typical, like in most other congeners, including both new species described above.

Gonopod drawings (Figs 12–13) are reproduced from the original description [Chamberlin, 1945]. The telopodites are sunken inside a shallow gonocoel, each telopodite is tripartite, showing two very long, slender, spiniform, simple branches which can be identified as a slightly shorter solenomere (**sl**) and a longer exomere (**ex**). A sac-shaped velum (**v**) lies at the base of both **sl** and **ex**.

Cryptocorypha tobana Chamberlin, 1945
Figs 14–18.

HOLOTYPE ♂ (AMNH), Indonesia, Sumatra, Lake Toba (Tobameer), March 1922. The label does not contain a collector's name, but Chamberlin [1945] attributes it to Dammerman.

DESCRIPTIVE REMARKS. The holotype is complete, presently fragmented, broken into three pieces (Figs 14–16), one of which is an isolated segment 7 with intact gonopods (Fig. 16). Body is with 20 segments (♂). Body width was originally stated to be 1.2 mm [Chamberlin, 1945]. The last tibia is with an evident trichostele.

All somatic characters are typical, like in most other congeners, including both new species described above.

Gonopod drawings (Figs 17–18) are reproduced from the original description [Chamberlin, 1945]. The telopodites are sunken inside a shallow gonocoel, each telopodite is tripartite, showing two long branches which can be identified as a slender, flagelliform and apically curved solenomere (**sl**) and a shorter, subunciform and apically fringed/fimbriate endomere (**en**). A sac-shaped velum (**v**) lies at the base of both **sl** and **en**.

A provisional key to *Cryptocorypha* species

The following key must be taken as only provisional, being chiefly based on ♂ characters, primarily gonopodal ones and using all available literature sources [Attems, 1907a, 1940, 1953; Brolemann, 1920; Carl, 1932; Chamberlin, 1945; Miyosi, 1957; Murakami, 1966; Loksa, 1967; Hoffman, 1977; Zhang, Li, 1981; Golovatch *et al.*, 2011, 2013, 2017; Golovatch, VandenSpiegel, 2015; Golovatch, Martens, 2018; Likhitrakarn *et al.*, 2019]. Given also the records of some already collected, but yet undescribed species and surely a wealth of further *Cryptocorypha* still to be found, consulting the above, mostly original sources for a secure identification is strongly advised. The number of body segments is of limited use, because too many species still remain known from the ♂ sex alone. The key holds solely for adults.

1(2) At least ♂ with 19 segments. Afrotropical species. .. 3
2(1) Either ♂ alone or both ♂ and ♀ with 19 or 20 segments. Mostly Asian species. 17
3(4) At least ♂ vertex with a paramedial pair of evident, usually medially separated, but sometimes fused, often more or less mushroom-shaped, squarish or ovoid protuberances. Congo. 5
4(3) Vertex devoid of protuberances. 15
5(6) Both vertigial protuberances fused medially into a single, large, squarish tubercle. Subapical lateral process on a very prominent lobe-shaped velum (**v**) stout, finger-shaped and fimbriate. .... *C. coalita*
6(5) Both vertigial protuberances clearly separated medially. A subapical lateral process on a similarly large and lobe-shaped or less prominent velum either rather slender and simple or absent. 7
7(8) Both vertigial protuberances ovoid. Sternal tubercle between gonopodal coxae densely denticulate. Velum somewhat less prominent, not entirely sheathing similarly high

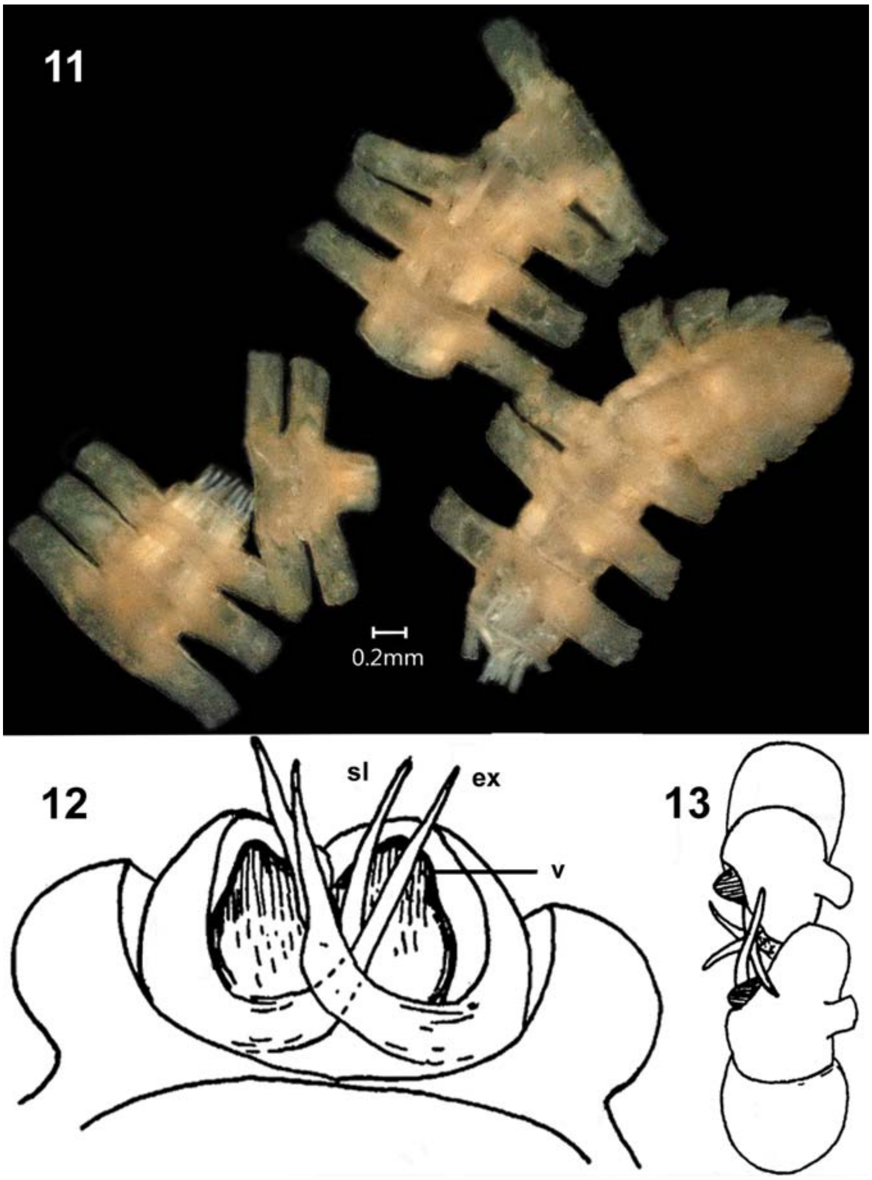


Fig. 11–13. *Cryptocorypha leia* Chamberlin, 1945, ♂ holotype: 11 — habitus (remaining body fragments); 12–13 — gonopods *in situ*, oral and ventral views, respectively. Scale bar: 0.2 mm (11); reproduced without scale (12–13, after Chamberlin [1945]). Picture 11 taken by Jennifer Trimble.

Abbreviations: ex — exomere; sl — solenomere; v — velum.

Рис. 11–13. *Cryptocorypha leia* Chamberlin, 1945, голотип ♂: 11 — общий вид (оставшиеся фрагменты тела); 12–13 — гоноподы на месте, соответственно спереди и снизу. Масштаб: 0,2 мм (11); воспроизведено без масштаба (12–13, по: Chamberlin [1945]). Фотография 11 сделана Jennifer Trimble.

Обозначения: ex — экзомер; sl — соленомер; v — парус.

and simple solenomere and exomere branches, all these remaining mostly detached from one another; a subapical lateral process on velum absent. .... *C. girafficeps*

8(7) Both vertigial protuberances mushroom-shaped or ovoid. Sternal tubercle between gonopodal coxae otherwise. Velum (**v**) prominent, entirely sheathing similarly high and simple solenomere (**sl**) and exomere (**ex**) branches; a subapical lateral process on velum either slender or absent. 9

9(10) Body larger, 8–12 mm long. Both solenomere (**sl**) and exomere (**ex**) long and spiniform. Velum (**v**) very prominent, lobe- or ear-shaped. Last tibia without trichostele, instead only a long tactile seta being present. 11

10(9) Body considerably smaller, only 5.5–6.5 mm long. Neither solenomere (**sl**) nor exomere (**ex**) spiniform. Velum (**v**) far less prominent, usually not lobe-shaped. Last tibia with a trichostele, even though supporting stalk small. 13

11(12) Metatergal tuberculations mostly round. Velum (**v**) with a characteristic distolateral uncus. .... *C. fungifer*

12(11) Metatergal tuberculations mostly transversely oval. Velum (**v**) devoid of a distolateral outgrowth. .. *C. bocal*

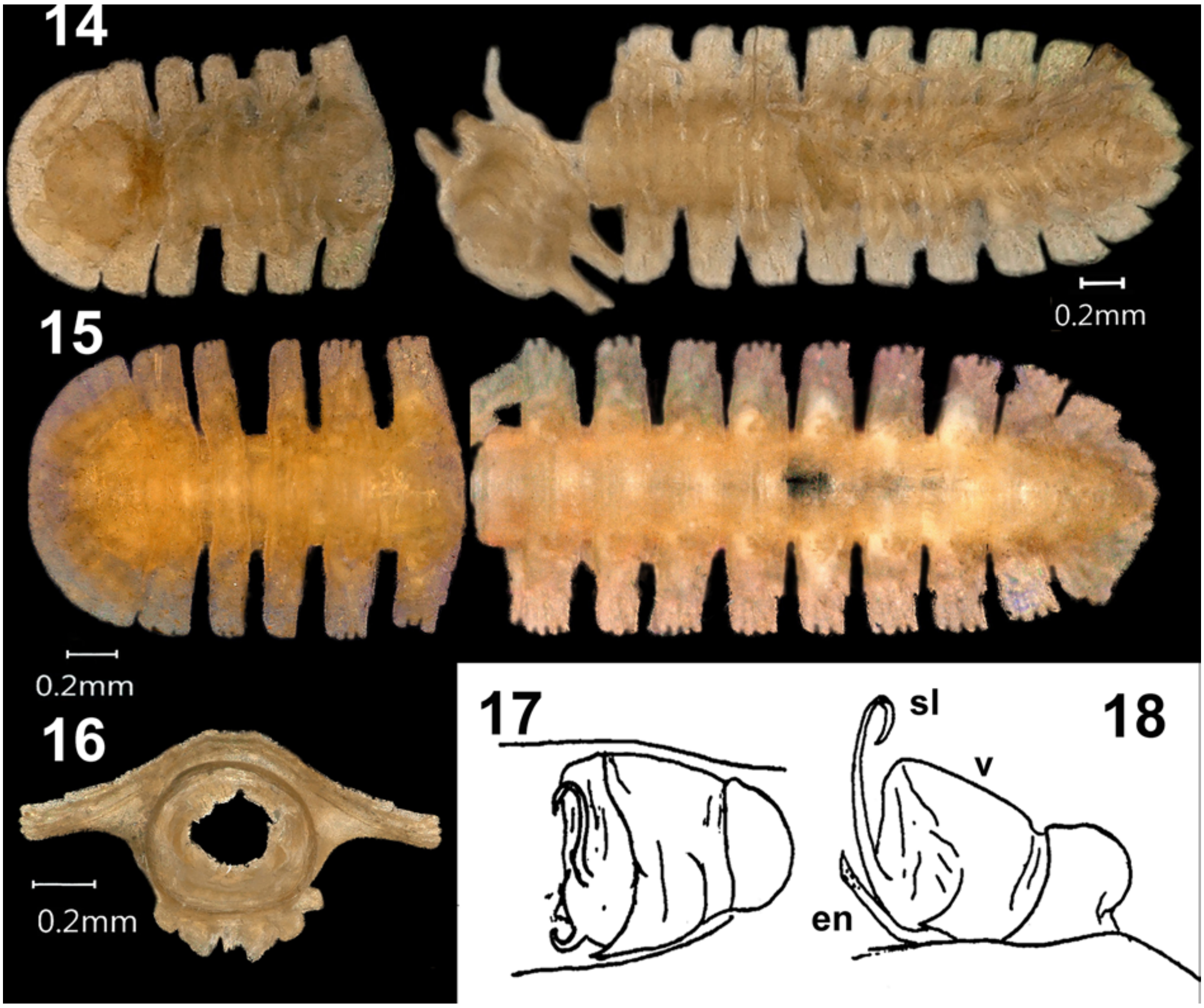


Fig. 14–18. *Cryptocorypha tobana* Chamberlin, 1945, ♂ holotype: 14–15 — habitus (remaining body fragments), ventral and dorsal views, respectively; 16 — segment 7 together with gonopods, oral view; 17–18 — right gonopod, ventral and oral views, respectively. Scale bars: 0.2 mm (14–16); reproduced without scale (17–18, after Chamberlin [1945]). Pictures 14–16 taken by Jennifer Trimble.

Abbreviations: en — endomere; sl — solenomere; v — velum.

Рис. 14–18. *Cryptocorypha tobana* Chamberlin, 1945, голотип ♂: 14–15 — общий вид (оставшиеся фрагменты тела), соответственно снизу и сверху; 17 — сегмент 7 вместе с гоноподами, спереди; 17–18 — правый гонопод, соответственно снизу и спереди. Масштаб: 0,2 мм (14–16); воспроизведено без масштаба (17–18, по: Chamberlin [1945]). Фотографии 14–16 сделаны Jennifer Trimble.

Обозначения: ex — эндомер; sl — соленомер; v — парус.

13(14) Both ♂ and ♀ with a paramedian pair of vertigial protuberances. Velum longer and slender, exomere (**ex**) slender. .... *C. monomorpha*

14(13) Only ♂ with a paramedian pair of vertigial protuberances. Velum (**v**) much shorter, but exomere (**ex**) prominent, axe-shaped apically. .... *C. dimorpha*

15(16) Lateral margin of paraterga 3- or 4-lobulate on poreless and pore-bearing segments, respectively, this being typical of the genus. Gonopods relatively simple, exomere (**ex**) being the highest branch, solenomere (**sl**) somewhat shorter, while velum (**v**) a small lateral lobe. Congo. .... *C. nympha*

16(15) Lateral margin of paraterga 3–15 largely 4- or 5-lobulate on poreless and pore-bearing segments, respectively. Gonopod relatively complex, exomere (**ex**) being the longest and especially complex branch, solenomere (**sl**) relatively short, while velum (**v**) a prominent, lateral, sac-shaped structure. East Africa (at least Tanzania and Kenya). .... *C. diffusa*

17(18) At least ♂ with 19 segments. Trichostele on last tibia present at least in ♀. 19

18(17) Both ♂ and ♀ with 20 segments. Trichostele on last tibia present or absent….. 23

19(20) Larger: length 9–10 mm, width ca. 2.0 mm. Gonopodal telopodite tripartite, with two very long, slender, spiniform, simple branches: a shorter solenomere (**sl**) and a longer exomere (**ex**); a sac-shaped velum (**v**) at base of both **sl** and **ex** (Figs 12–13). Java, Indonesia.... .... *C. leia*

20(19) Smaller: length 8 mm, width 1.3 mm. Gonopodal telopodite tri- or quadripartite, shapes of outgrowths otherwise. 21

21(22) Smaller: length 4.5–5 mm, width 0.5–0.6 mm. Gonopodal telopodite tripartite: **sl** bifid, **ex** long and thick, with a retrose acuminate apex, **v** the highest, irregularly sac-shaped, with a flagelloid at base on medial face. Vanuatu, Melanesia. .... *C. chernovi*

22(21) Larger: length 5–8 mm, width 1.1–1.3 mm. Gonopodal telopodite quadripartite: **sl** the longest, apically spinulose, only a little longer than subequally high, a prominent sac-shaped **v**, a slender **en**, and a spinulate **ex**, the latter either tightly attached or largely fused to **v**. Java, Indonesia. .... *C. stylopus*

23(24) Among the smallest: length 4–4.5 mm. Trichostele on last tibia absent. Gonopodal telopodite bipartite: a short, papillate, rod-shaped, subtruncate **sl** fully concealed by a hypertrophied, setose telopodite+**v**. Southern Vietnam. .... *C. hoffmani*

24(23) Usually larger. Trichostele on last tibia present or absent. Gonopodal telopodite tri- or quadripartite. ... 25

25(26) Among the largest: length 10 mm, width 1.9 mm. 27

26(25) Smaller. 31

27(28) The largest: length 12–15 mm, width 2.6–3.4 mm. Gonopodal telopodite quadripartite: **sl** the highest, as slender as a slightly shorter and closely appressed **en**; **ex** short and tuberculate-spinulate, **v** a low and small lobe. Northern Thailand. .... *C. enghoffi*

28(27) Smaller. Gonopodal telopodite tri- or quadripartite, in any case all outgrowths shaped otherwise. 29

29(30) Length 10–11 mm, width 1.9–2.0 mm. Trichostele on last tibia present. Gonopodal telopodite quadripartite, with the highest and slender **sl**, somewhat lower and subequally long **ex** (densely spiculate) and **en**, and a low and simple **v** with a short, laterobasal, spiculate stump. Myanmar. .... *C. perplexa*

30(29) Length 9–12, width 2.4-2.5 mm. Trichostele on last tibia absent. Gonopodal telopodite tripartite: **v** hypertrophied, sac-shaped, apically rounded, a little higher than an apically plumose **sl** and much higher than a short, apically spiculate **ex**. Guangxi, southern China. ....*C. spinicoronata*

31(32) Trichostele on last tibia absent. 33

32(31) Trichostele on last tibia present. 41

33(34) Body stouter: length 7 mm, width 2.9 mm, i.e. length/width ratio ca. 2.4 (Figs 1–2). Gonopodal telopodite quadripartite: a conspicuous, long, ribbon-shaped, acuminate **en** about as high as a slender, distally rugulose, unciform and also acuminate **sl**, followed first by a simple and lower sac-shaped **v** and then a relatively short, erect, basally densely setose, rod-shaped, apically vaguely bifid **ex** (Figs 4–5). Laos. .... *C. bicolorata* sp.n.

34(33) Even when length comparable, body considerably more slender. Gonopodal telopodite tri- or quadripartite, but shapes of outgrowths otherwise. 35

35(36) Length 8–10 mm, width 1.6–1.8 mm. Gonopodal telopodite tripartite: both **sl** and **ex** bifid and somewhat shorter that a hypertrophied **v** with an anterolateral outgrowth. Southern India. .... *C. tuberculata*

36(35) Body smaller, length 5–6 mm, width 1.2–1.3 mm. Gonopodal telopodite tri- or quadripartite, but shapes of outgrowths otherwise. 37

37(38) Gonopodal telopodite quadripartite: an apically plumose and slender **sl** only very slightly higher than a very prominent and densely spiculate **v** and a distomesally slightly spinulate and slender **en**, while **ex** a curved, thick, distally denticulate, lateral process. Nearly pantropical. .... *C. ornata*

38(37) Gonopodal telopodite tri- or quadripartite. 39

39(40) **sl** the longest, ribbon-shaped, papillate and acuminate, only a little longer than a voluminous, squarish, densely papillate/granulate **v** and much longer than a curved and denticulate **ex**. Kyushu, Japan. .... *C. kumamotensis*

40(39) **sl** the longest, apically branching and plumose; both **en** and **v** subequal in height, medium-sized, 2/3 as high as **sl**. Sri Lanka. .... *C. kandyana*

41(42) Larger: length 8–10 mm, width 1.6–1.9 mm. Gonopodal telopodite quadripartite: a short, ribbon-shaped, curved and apically rounded **en** at base of the longest, distally curved, conspicuously and densely fringed/fimbriate, apically palm-shaped **sl**, followed first by a sac-shaped, mesally irregularly membranous **v** and then by a large, clearly papillate/dentate, gently curved, somewhat clavate **ex** (Figs 9–10). Northern Thailand. .... *C. jaegeri* sp.n.

42(41) Smaller: length 4–6 mm. width 0.7–1.2 mm. Gonopodal telopodite tripartite. 46

43(44) Postcollum metaterga clearly areate. Gonopodal telopodite: **sl** the highest and plumose apically, **ex** spiculate, and **v** high and sac-shaped. Southern India. ....*C. areata*

44(43) Postcollum metaterga tubercolate, areations, if any, vague. Gonopodal telopodite otherwise. 45

45(46) Gonopodal telopodites unusually slender and elongate, **sl** the longest, simple; **v** a high round lobe, only a little lower than **sl**; **ex** strong, papillate and anchoriform, somewhat shorter than **v**. Southern India and Mauritius. ....*C. riparia*

46(47) Gonopodal telopodites clearly transverse and stout, outgrowths otherwise. 48

48(49) Two branches particularly long: a slender, flagelliform and apically curved **sl** and a shorter, subunciform and apically fringed/fimbriate **en**, with a sac-shaped **v** at base of both (Figs 17–18). Sumatra, Indonesia. .... *C. tobana*

49(48) **sl** the longest, strongly plumose/fimbriate in distal half; both a voluminous sac-shaped **v** and a distally denticulate and tightly appressed **ex** subequal in height. Tokyo, Japan. .... *C. japonica*

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